CUTTING COSTS

IN CONCRETE FRAME CONSTRUCTION

WITH 'INCOR' 24-HOUR CEMENT

On "rush" jobs, many contractors automatically turn to 'Incor' 24-Hour Cement. And for sound reasons, as this 7-story Greenville, Miss., hotel job aptly illustrates:

Working against a $50-a-day bonus-penalty, the contractor first tried a rich mix of ordinary Portland cement, which gave him stripping strengths in 7 days. By shifting to 'Incor', using a normal mix, he obtained stripping strengths in 3 days, at a lower cement cost. 'Incor' enabled the contractor to finish the job 30 days ahead of schedule, earning a $1500 bonus.

But it doesn't have to be a "rush" job for 'Incor' to save money. By analyzing any job, whether it is rush or not, substantial savings can usually be shown, as the facts presented on the following pages clearly show.

Cover illustration: La Tribuna Building, Montevideo, built with cement produced by International Cement Corporation's Uruguay subsidiary—interesting example of concrete-frame construction.

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IN CONCRETE FRAME CONSTRUCTION

FOREWORD

"Profit usually hinges on the savings realized through good job organization," says a well-known contractor.

True enough—but isn't it often a case of saving at the spigot—by centering attention on direct costs for labor and materials; only to let profits run out of the bung-hole—through needlessly heavy overhead?

Take, for example, the problem of non-productive time—the time required for concrete to attain service strength—those "dead" days when frame-erection stands still while overhead expense keeps piling up.

Many contractors look upon these "dead" days as a necessary evil; others fail to appreciate their cost in dollars-and-cents. Yet, experience shows that this non-productive time can usually be avoided, at a substantial net reduction in cost.

To save these "dead" days, some contractors still think only in terms of a second set of forms. But there is another alternative which, on all but the tallest buildings, is at once a more certain and more economical solution—that is, 'Incor' 24-Hour Cement.

'Incor' is an improved Portland cement—it cures or hardens in one-fifth the usual time. Because it is self-supporting in 24 to 48 hours, instead of 5 days or longer, 'Incor' does away with non-productive time in concrete-frame erection. Resulting economies usually offset 'Incor's moderate extra cost and show the contractor a worth-while net saving.

To help the contractor decide when and where to use 'Incor', the Lone Star Cement Corporation has analyzed a wide range of concrete-frame erection schedules. Conclusions drawn from this analysis are here presented.

'Incor' Cement isn't advanced as a cure-all! We have been making Lone Star Portland Cement for 30 years and 'Incor' for 10; and we know of course that there is a definite place for both. Our job is to give the contractor facts which enable him to decide when 'Incor's high early and ultimate strengths and greater curing efficiency can save him money and produce better concrete. And that, so far as concrete-frame erection is concerned, is the purpose of this book.

PLANNING THE JOB

COSTS of concrete-frame erection divide two ways: (1) Direct costs for labor and materials; (2) indirect or overhead costs. Both are affected by size and location of job; the contractor can vary his direct costs somewhat—but usually not a great deal. Where he *can* save is on indirect or overhead costs—by eliminating non-productive time; that is, the time required for concrete to attain service strength—"dead" days when frame erection stands still.

While concrete cures, time-costs or overhead runs on day after day, whether work on the frame proceeds or not. These 'On-the-Job' costs include:

1. Salaried payroll: superintendence, foremen, job-office staff, etc.; also proportion of administrative expense.

2. Plant rental or per diem plant charges: which should be charged against a job at commercial rental rates.

3. Insurance: liability, compensation, fire, etc., which runs on a calendar basis.

4. Service charges: electricity, telephone, water, etc.

5. Contingent expenses: a variety of items which every contractor incurs just for being on the job. Also reserves for lost time, weather interference, etc.

6. Interest charges: which run along on a time basis.

All of these 'On-the-Job' costs represent time; the longer a contractor is on a given job, the higher these expenses pile up. Thus, if these costs amount to $100 a day and it takes 70 working days to erect the frame, overhead costs amount to $7,000. If sound planning can eliminate 35 non-productive days, there is obviously a saving of $3,500 in the cost of frame construction. That is the value of time—the cost of being on the job—as separate and distinct from the cost of materials and the labor cost of placing them.

To find out how these 'On-the-Job' costs can be reduced by careful planning and material selection, typical erection schedules have been analyzed, with due regard to the various phases of the concreting operation, as follows:

FORM ASSEMBLY

On any job it is necessary first to determine how much work has to be done before concrete can be poured. Sometimes, as in a warehouse, it is merely a case of erecting simple forms and placing re-inforcement. Again, as in hotels, hospitals or apartment buildings, with a lot of equipment, inserts, wiring and plumbing to be accurately set, more time is required for building "make-ready."

Here, too, the element of overhead expense enters. It may, for example, pay to put on more labor to complete form assembly, say, in 4 days instead of 5, in order to save a day's overhead on each assembly. To illustrate:

By comparing 'Incor' and ordinary cement erection schedules, the contractor found that 'Incor' saved 10 working days on City Hospital, Tyler, Texas. Overhead costs were $25 a day, low for this type of work; 10 days saved meant $250. He also saved $400 on forms. Total saving—$650. Extra cost of 'Incor'—$308.75. Net saving—$341.25.

If labor for 5-day assembly costs $200 a day and overhead is $100 a day, the contractor can afford to spend up to $275 a day for labor to complete assembly in 4 days, and still break even. Anything less than $275 a day for labor to accomplish 4-day assembly is a clear saving. It pays to analyze a job to find out the most economical assembly time.

CONCRETING SCHEDULE

Contractors usually form in units which can be concreted in one day; that is, between starting time in the morning and, say, 2 o'clock in the afternoon. Even on large jobs, pouring is advantageously done in units of that size, in order to pour and finish the concrete and clean up without overtime.

With 'Incor', it is possible to pour concrete an hour longer, because finishing can begin sooner.

"DEAD" TIME

The next cost factor is governed by the length of the interval between the pour and the time when form-stripping and re-assembly can begin. While concrete cures, work on the frame stops. The longer this interval of non-productive time, the higher the cost, because overhead runs on steadily. Also, while concrete cures, other work has to be found for carpenter, concrete and labor crews, or some of the men have to be laid off. In either case, labor efficiency is reduced, man-hour production lowered and labor costs increased.

FORM STRIPPING

The length of this non-productive time interval depends upon the hardening properties of the concrete and the relation of dead to live load. Form-removal specifications should reflect these conditions. However, many specifiers put the responsibility for form-removal squarely up to the contractor, on the ground that, if you are employing competent construction ability, this is the most practical way to handle the problem.

WHAT 'INCOR' DOES

'Incor' is an improved Portland cement; it cures five times as efficiently as ordinary cement. Hence, 'Incor' is self-supporting in one-fifth the usual time. Because of greater precision employed at every stage of the manufacturing process, 'Incor' costs more; so, its use depends upon whether the

SCHEDULE No. 1 'INCOR'

Work Week . . . . . 5 days
Number of Form Sets 1
Forms—Stripping, Assembly, Steel Setting . . 5 days
Forms—Removal after Concrete Placed . . . 1 days

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1 S	2 S	3 S	4 S	5 S	6	7
8 P1	9 S	10 S	11 S	12 S	13	14
15 S	16 P2	17 S	18 S	19 S	20	21
22 S	23 S	24 P3	25 S	26 S	27	28
29 S	30 S	31 S	32 P4	33 S	34	35
36 S	37 S	38 S	39 S	40 P5	41	42
43 S	44 S	45 S	46 S	47 S	48	49
50 P6	51 S	52 S	53 S	54 S	55	56
57 S	58 P7	59	60	61	62	63
64	65	66	67	68	69	70
71	72	73	74	75	76	77
78	79	80	81	82	83	84
85	86	87	88	89	90	91
92	93	94	95	96	97	98
99	100	101	102	103	104	105
106	107	108	109	110	111	112
113	114	115	116	117	118	119

Working Time . 42 days Elapsed Time . 58 days

SCHEDULE No. 2 ORDINARY PORTLAND

Work Week . . . . . 5 days
Number of Form Sets 1
Forms—Stripping, Assembly, Steel Setting . . 5 days
Forms—Removal after Concrete Placed . . . 10 days

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1 S	2 S	3 S	4 S	5 S	6	7
8 P1	9 C	10 C	11 C	12 C	13 C	14 C
15 C	16 C	17 C	18 S	19 S	20	21
22 S	23 S	24 S	25 P2	26 C	27 C	28 C
29 C	30 C	31 C	32 C	33 C	34 C	35
36 S	37 S	38 S	39 S	40 S	41	42
43 P3	44 C	45 C	46 C	47 C	48 C	49 C
50 C	51 C	52 C	53 S	54 S	55	56
57 S	58 S	59 S	60 P4	61 C	62 C	63 C
64 C	65 C	66 C	67 C	68 C	69 C	70
71 S	72 S	73 S	74 S	75 S	76	77
78 P5	79 C	80 C	81 C	82 C	83 C	84 C
85 C	86 C	87 C	88 S	89 S	90	91
92 S	93 S	94 S	95 P6	96 C	97 C	98 C
99 C	100 C	101 C	102 C	103 C	104 C	105
106 S	107 S	108 S	109 S	110 S	111	112
113 P7	114	115	116	117	118	119

Working Time . 81 days Elapsed Time . 113 days

SCHEDULE No. 3 ORDINARY PORTLAND

Work Week . . . . . 5 days
Number of Form Sets 2
Forms—Stripping, Assembly, Steel Setting . . 5 days
Forms—Removal after Concrete Placed . . . 10 days

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1 S	2 S	3 S	4 S	5 S	6	7
8 P1	9 CS	10 CS	11 CS	12 CS	13 C	14 C
15 CS	16 CP2	17 CC	18 CS	19 CS	20 C	21 C
22 CS	23 CS	24 CS	25 CP3	26 CS	27 C	28 C
29 CS	30 CS	31 CS	32 CS	33 CP4	34 C	35 C
36 CS	37 CS	38 CS	39 CS	40 CS	41 C	42 C
43 P5	44 CS	45 CS	46 CS	47 CS	48 C	49 C
50 CS	51 CP6	52 CC	53 CS	54 CS	55 C	56 C
57 CS	58 CS	59 CS	60 CP7	61	62	63
64	65	66	67	68	69	70
71	72	NOTE—Second form set indicated by italic (S)			76	77
78	79				83	84
85	86	87	88	89	90	91
92	93	94	95	96	97	98
99	100	101	102	103	104	105
106	107	108	109	110	111	112
113	114	115	116	117	118	119

Working Time . 44 days Elapsed Time . 60 days

SCHEDULE No. 4 ORDINARY PORTLAND

Work Week . . . . . 6 days
Number of Form Sets 1
Forms—Stripping, Assembly, Steel Setting . . 5 days
Forms—Removal after Concrete Placed . . . 10 days

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1 S	2 S	3 S	4 S	5 S	6 P1	7 C
8 C	9 C	10 C	11 C	12 C	13 C	14 C
15 C	16 S	17 S	18 S	19 S	20 S	21
22 P2	23 C	24 C	25 C	26 C	27 C	28 C
29 C	30 C	31 C	32 S	33 S	34 S	35
36 S	37 S	38 P3	39 C	40 C	41 C	42 C
43 C	44 C	45 C	46 C	47 C	48 S	49
50 S	51 S	52 S	53 S	54 P4	55 C	56 C
57 C	58 C	59 C	60 C	61 C	62 C	63 C
64 S	65 S	66 S	67 S	68 S	69 P5	70 C
71 C	72 C	73 C	74 C	75 C	76 C	77 C
78 C	79 S	80 S	81 S	82 S	83 S	84
85 P6	86 C	87 C	88 C	89 C	90 C	91 C
92 C	93 C	94 C	95 S	96 S	97 S	98
99 S	100 S	101 P7	102	103	104	105
106	107	108	109	110	111	112
113	114	115	116	117	118	119

Working Time . 87 days Elapsed Time . 101 days

Legend: S = Stripping and Assembly P = Placing C = Curing Time

FIG. 1: Typical erection schedules for 6-story-and-roof building, 5-day form assembly, 1 day for pouring. Schedule (1) based on use of 'Incor', 24-hour form removal; schedules (2), (3), (4) based on 10-day curing with ordinary cement, one and two form-sets, 5-day and 6-day week. Tables I and II, pages 6-7, summarize 80 similar erection schedules, show time required to erect and cure frames of 1 to 16 floors, for various form-assembly and curing periods — enabling contractor quickly to determine when to use 'Incor' 24-Hour Cement.

value of the time it saves exceeds the added cost.

Thus, if the value of the days saved per floor is greater than the extra cost of 'Incor' in the floor, then 'Incor' is a source of reduced cost or increased profit to the contractor. If it costs more than it saves, 'Incor' can help deliver the job sooner, but at added cost to the contractor, which the owner may of course be willing to assume, because his investment becomes productive sooner.

'INCOR' vs. EXTRA FORM-SET

Analysis of typical erection schedules shows that 'Incor' is almost invariably cheaper than a second form-set. It is easy to demonstrate this for any given job by figuring the cost of the extra set of forms for the number of floors on which it will be used, setting the cost per floor against the added cost of 'Incor' per floor—bearing in mind, also, that form-handling costs tend to increase with the number of form-sets in use.

The only place in the erection of a building where time can be saved without running into overtime and increased expense is in the erection of the frame. Enclosing, follow-up operations and everything else wait on the frame. 'Incor' usually makes it possible to speed up schedules without increasing expense—many times at a substantial saving. The following analyses indicate the range of these economies.

TABLES I-II Based on 80 erection schedules similar to those shown in Fig. 1, page 5. Table I shows, for a 5-day week, number of working days required to erect concrete frames, 1 to 16 floors, for four different form-assembly periods, six different curing periods, with one and two sets of forms. To find cash saving made possible by using 'Incor', multiply number of days saved by daily overhead expense, and compare this saving with extra cost of 'Incor'. Table II gives same information for 6-day week.

ERECTION C

IN this analysis, the three operations in the erection of a frame are considered:

1. *Stripping and Assembly:* Days consumed in taking down, re-shaping and re-assembling forms; placing steel, conduits, plumbing, etc.; that is, all the work that has to be done before concrete is poured. (Designated as "S" days on typical erection schedules shown in Fig. 1.)

2. *Placing Concrete:* Days on which concrete is placed. (Designated as "P" days.)

3. *Curing Time:* "Dead" days elapsing after concrete is placed, waiting for it to harden and before form removal can be started. (Designated as "C" days.)

Table I—Summary: Working days required for completion of concrete frame for different forming and curing schedules.

CEMENT	Schedule: Forming	Schedule: Curing	5-DAY WEEK: Workdays Required to Erect Frame of 1 to 16 Floors															
	Days		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 SET OF FORMS																		
'INCOR'	2	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
	3	1	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
	4	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	1	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	2	2	3	7	11	15	18	22	26	30	33	37	41	45	48	52	56	60
	3	2	4	9	14	19	24	29	34	39	44	49	54	59	64	69	74	79
	4	2	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	2	6	13	20	26	33	40	46	53	60	66	73	80	86	93	100	106
ORDINARY PORTLAND CEMENT	2	5	3	8	13	18	23	28	33	38	43	48	53	58	63	68	73	78
	3	5	4	10	16	24	30	36	44	50	56	64	70	76	84	90	96	104
	4	5	5	12	20	27	35	42	50	57	65	72	80	87	95	102	110	117
	5	5	6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156
	2	7	3	10	17	24	31	38	45	52	59	66	73	80	87	94	101	108
	3	7	4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124
	4	7	5	14	23	32	41	50	59	68	77	86	95	104	113	122	131	140
	5	7	6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156
	2	10	3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153
	3	10	4	14	24	34	44	54	64	74	84	94	104	114	124	134	144	154
	4	10	5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155
	5	10	6	19	31	44	56	69	81	94	106	119	131	144	156	169	181	194
	2	14	3	15	27	39	51	63	75	87	99	111	123	135	147	159	171	183
	3	14	4	17	30	43	56	69	82	95	108	121	134	147	160	173	186	199
	4	14	5	19	33	47	61	75	89	103	117	131	145	159	173	187	201	215
	5	14	6	21	36	51	66	81	96	111	126	141	156	171	186	201	216	231
2 SETS OF FORMS																		
ORDINARY PORTLAND CEMENT	2	5	3	6	9	13	16	19	23	26	29	33	36	39	43	46	49	53
	3	5	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
	4	5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	5	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	2	7	3	6	10	13	17	20	24	27	31	34	38	41	45	48	52	55
	3	7	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
	4	7	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	7	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	2	10	3	6	13	16	23	26	33	36	43	46	53	56	63	66	73	76
	3	10	4	8	14	19	24	29	34	39	44	49	54	59	64	69	74	79
	4	10	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	10	6	12	19	25	31	37	44	50	56	62	69	75	81	87	94	100
	2	14	3	6	15	18	27	30	39	42	51	54	63	66	75	78	87	90
	3	14	4	8	17	21	30	34	43	47	56	60	69	73	82	86	95	99
	4	14	5	10	19	24	33	38	47	52	61	66	75	80	89	94	103	108
	5	14	6	12	21	27	36	42	51	57	66	72	81	87	96	102	111	117

T ANALYSIS

These "C" days are non-productive time—days when costs run on and no productive work is done on the frame. *The "S" and "P" days are fixed by job conditions; but the "C" days are in the control of the contractor. Proper planning and selection of materials can reduce or eliminate them.*

Of 80 erection schedules analyzed, four are shown in Fig. 1 for a 6-story and roof building. They are based on 5-day form assembly, with one day for pouring. Schedule (1) in Fig. 1 is based on the use of 'Incor', with form removal beginning the day following the pour; schedules (2), (3) and (4) are based upon ten-day curing with ordinary Portland cement.

The 'Incor' schedule shows one floor poured every six working days. With ordinary Portland cement, see schedule (2), a floor is poured every 13 working days. Result, 'Incor' cuts the number of working days in half—42 days for 'Incor' against 81 days for ordinary cement. 39 non-productive days saved.

Schedule (3) shows what happens when working time is reduced by using two sets of forms. Pouring days are practically the same as with 'Incor', one floor per week; for seven floors, total working days are 44—two more than with 'Incor'. Here, 'Incor' saves the cost of an extra form-set.

Schedule (4) shows the same erection schedule for a 6-day week, using ordinary Portland cement and one set of forms. Here, one floor is poured every 13 working days, but the total number of working days is increased to 87—51 days saved by the use of 'Incor'.

Similar erection schedules covering various combinations of assembly and curing time, for one and two sets of forms, are summarized in Tables I and II, for a 5- and a 6-day week, respectively.

These Tables show the number of working days required to erect concrete building frames of from 1 to 16 floors, for four different periods of form assembly and six different curing periods. The number of days saved by using 'Incor' is readily obtained by comparing the 'Incor' and ordinary Portland cement erection schedules.

No attempt has been made to lay down specific costs for any given job. Instead, this analysis, by indicating the range of the problem, enables the contractor quickly to determine where the use of 'Incor' is justified. To illustrate:

First, calculate the value of a working day—that is, total overhead expense, made up of—

Salaried Payroll: superintendent, assistant superintendent, timekeeper and accountant, watchman, labor foreman, carpenter foreman, steel reinforcement foreman, hoisting engineer, etc.; as well as proportion of administrative expense.

Equipment: plant rental.

Table II—Summary: Working days required for completion of concrete frame for different forming and curing schedules.

CEMENT	Schedule: Forming	Schedule: Curing	6-DAY WEEK: Workdays Required to Erect Frame of 1 to 16 Floors															
	Days		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 SET OF FORMS																		
'INCOR'	2	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
	3	1	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
	4	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	1	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	2	2	3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63
	3	2	4	9	14	19	24	28	33	38	43	48	52	57	62	67	72	76
	4	2	5	11	17	23	29	35	41	47	53	59	65	71	77	83	89	95
	5	2	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
ORDINARY PORTLAND CEMENT	2	5	3	9	15	21	27	33	39	45	51	57	63	69	75	81	87	93
	3	5	4	11	18	25	33	40	47	54	61	69	76	83	90	97	105	112
	4	5	5	13	22	30	38	47	55	63	72	80	88	97	105	113	122	130
	5	5	6	15	24	33	42	51	60	69	78	87	96	105	114	123	132	141
	2	7	3	11	19	27	35	43	51	59	67	75	83	88	93	101	109	117
	3	7	4	13	22	31	40	49	58	67	76	85	94	103	112	121	130	139
	4	7	5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155
	5	7	6	17	28	39	50	61	72	83	94	105	116	127	138	149	160	171
	2	10	3	14	25	36	46	57	68	79	90	100	111	122	133	144	154	165
	3	10	4	16	28	40	52	64	76	88	100	112	124	136	148	160	172	184
	4	10	5	17	29	41	53	65	77	89	101	113	125	137	149	161	173	185
	5	10	6	19	33	47	60	73	87	101	114	127	141	155	168	181	195	209
	2	14	3	17	31	45	59	73	87	101	115	129	143	157	171	185	199	213
	3	14	4	19	34	49	64	79	94	109	124	139	154	169	184	199	214	229
	4	14	5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245
	5	14	6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261
2 SETS OF FORMS																		
ORDINARY PORTLAND CEMENT	2	5	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
	3	5	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
	4	5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	5	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	2	7	3	6	11	14	19	22	27	30	35	38	43	46	51	54	59	62
	3	7	4	8	13	17	22	26	31	35	40	44	49	53	58	62	67	71
	4	7	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	5	7	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
	2	10	3	6	14	17	25	28	36	39	46	50	57	61	68	72	79	82
	3	10	4	8	16	20	28	32	40	44	52	56	64	68	76	80	88	92
	4	10	5	10	17	23	29	35	41	47	53	59	65	71	77	83	89	95
	5	10	6	12	19	25	33	39	47	53	60	66	73	79	87	93	101	107
	2	14	3	6	17	20	31	34	45	48	59	62	73	76	87	90	101	104
	3	14	4	8	19	23	34	38	49	53	64	68	79	83	94	98	109	113
	4	14	5	10	21	26	37	42	53	58	69	74	85	90	101	106	117	122
	5	14	6	12	23	29	40	46	57	63	74	80	91	97	108	114	125	131

Miscellaneous: liability insurance, telephone, light and water, incidentals.

The sum of these items is total weekly overhead. Details vary with locality, job size and job organization; eliminating the exceptionally large job, these costs generally range from $25 to $250 per day.

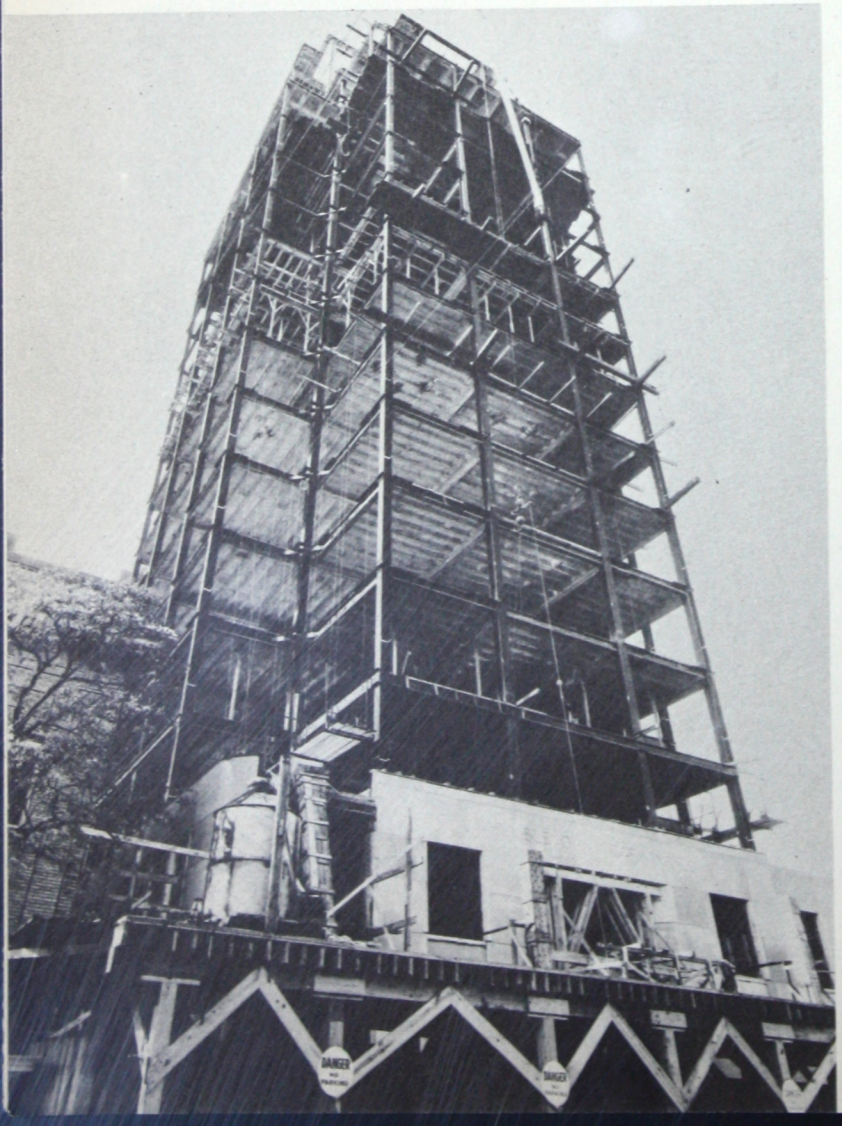
Then, from Table I or II (for 5- or 6-day week) find the number of days saved by using 'Incor' under given job conditions.

Finally, figure the added cost of 'Incor'. This depends on yardage of concrete involved and required cement content per cu. yd.; usual range is from $0.65 to $1 more per cu. yd. for 'Incor' concrete.

Then, a simple calculation makes it easy to find the net saving obtained with 'Incor'.

EXAMPLE

6-story-and-roof building.....area 10,000 sq. ft.
5-day work-week
Form lumber, 55,000 board feet for one form-set, including 10% waste, at.....$25 per M.
Labor for making forms.....16 per M.
Total form cost.....$41 per M.
Total Concrete—1300 cu. yds.
Added cost of 'Incor'—$0.75 per cu. yd.
Overhead, $300 per week—$60 per day.
Form-assembly: 5 days.
Curing: 10 days with ordinary cement—1 day with 'Incor'.



Erection days required (see Table I)
with ordinary cement.....81 days
with 'Incor'.....42 days
'Incor' saves.....39 days

COSTS

With 'Incor':
'Incor' saves 39 days at $60.....$2340
Added cost of 'Incor':
1300 cu. yds. x $0.75.....975
Net saving.....$1365

With extra form-set:
Cost of extra form-set
55 M. x $41.....$2255
Extra form-set saves 37 days (see Table I) at $60.....2220
Net extra cost.....$ 35

On this job, a second form-set increases costs by $35—while 'Incor' saves $1365. In other words, 'Incor' is $1400 cheaper than an extra form-set. These savings increase when the difference in curing periods is greater. 'Incor's high-early-strength also reduces re-shore requirements—a further saving not included in the foregoing calculations.

WHEN SCHEDULES ARE UPSET

On jobs that are more or less typical from floor to floor, 'Incor' enables the contractor to work at maximum speed with the minimum number of form-sets. Where a net saving is shown, it is manifestly unsound not to use it. But even on jobs where no overall economy is apparent, 'Incor' often shows substantial savings when used on one or more floors. To illustrate:

If days are lost through rain, or the schedule falls behind due to other causes, planned progress can be restored by pouring one or more floors with 'Incor'. Thus, with a 5-day week, 4-day assembly and 10-day curing with ordinary cement, if rain prevents work on a pouring day, the erection schedule is lengthened by 5 working days. Pouring the next floor with 'Incor' will save these 5 days, put the job back on schedule, and usually show a net saving.

To keep pace with speed of steel-frame erection often means two or more form-sets. With 'Incor', one form-set usually does the job. Humble Oil Company's 15-story office building, Houston, Texas, illustrates another aspect of the same problem. Changes in mechanical plans caused 6-weeks' delay. Steel frame had been erected; forms for concrete floors, joist and pan construction, were in place on five floors. Concreting had to be speeded up. Specifications required 14-day form removal with ordinary cement—2- and 3-day stripping with 'Incor'. 'Incor' made up lost time, saved 3 complete form-sets, material cost $700 per set, or $2100. Plus 12 days overhead, $250 a day, or $3000. Total saving—$5100. Extra cost of 'Incor'—$850. Net saving—$4250.

Suffolk Downs, East Boston, Mass., race-track grandstand, required placing over 8000 cu. yds. of concrete between May 24th and June 21st—less than one month. Concrete was poured in 10 main sections. With ordinary cement forms would have remained in place 6 days, requiring purchase of form lumber for entire job. Two-day stripping with 'Incor' released forms for prompt re-use, reduced lumber requirements 62½%. Saving on form material and make-up—$10,000. Extra cost of 'Incor'—$3000. Net saving—$7000.

EXAMPLE

160 cu. yds. concrete per floor.
Added cost of 'Incor' per cu. yd.—$0.75
Overhead $50 per day.
Days saved—5 at $50 ..... $250
Added cost of 'Incor':
160 x $0.75 120
Net saving $130

Stated another way, as long as the cost of being on this job exceeded $24 per day, it would pay to use 'Incor'.

Contractors also find that it frequently pays to pour the first and second floors with 'Incor', in order to get the job started and permit the use of these floors for off-street storage of material—and to enable follow-up trades to start work promptly on floors free of reposting.

OTHER FORM ECONOMIES

There is, of course, a practical limit to the number of times a form-set can be re-used—usually 8 or 10 times for a well-built set. It follows that a building having more than 8 or 10 typical floors requires two sets of forms. Under these conditions, 'Incor' will produce substantial savings only when curing periods of 10 days or more are required with ordinary cement. However, as there are seldom more than 10 typical floors in a building, one form-set plus 'Incor' Cement will usually reduce costs on that portion at least.

Floors do not have to be absolutely typical throughout; forms for typical panels can be re-used, with special panels where needed.

In hotels, hospitals and similar structures, the first two or three floors are usually not typical and have to be framed individually. When the contractor gets above these floors, however, typical floor arrangements make it possible for one form-set and 'Incor' to produce substantial savings.

Form re-use is not limited to tall buildings. Often a structure of moderate height which has similar wings or is symmetrical about its center line offers excellent opportunities for form economies through re-use. In these cases, one wing or portion of the building is carried up and the forms shifted over to the incompleted portion.

In steel-frame structures on which concrete is used for floors and fire-proofing, maximum progress with minimum forms accompany the use of 'Incor'. Steel erection is speeded up by having ready-to-use floors when and where needed.

Finally, on rush jobs, where on-time completion with ordinary cement often means excessive form quantities, 'Incor' usually does the job with a normal amount of forms and in less time—at a saving well worth estimating.

Highland Hall Dormitory, Louisiana State University, Baton Rouge, had to be completed for school opening. Using 'Incor,' it took only 19 days from time building layout started until last of 1500 cu. yds. of concrete was placed. One floor was poured every other day, re-using 1st and 2nd floor forms for 3rd floor and roof. Contractor saved 35,000 board feet of form material. He estimates 'Incor' saved $4200.

CONCRETING SUGGESTIONS

FORM REMOVAL: Floors are designed to carry their own weight plus the superimposed or live load. Live loads generally range from 40 lbs. per sq. ft. in apartment buildings, up to 250 or 300 lbs. in industrial buildings. The lighter the live load and the greater the span, the longer the forms should remain in place; because here the dead weight is a larger proportion of the total load which the floor is designed to carry.

Forms can be removed safely when the concrete has a compressive strength equal to about 3 times the stresses produced by the dead load. Thus, if these stresses are, say, 400 lbs. per sq. in., forms can be removed when concrete has a strength of 1200 lbs. per sq. in. Fig. 2-3 indicate when the required strengths can be expected with 'Incor' and ordinary Portland cement.

CONCRETE STRENGTHS: Fig. 2-3 show the strength-gaining characteristics of 'Incor' and ordinary cement for different water contents at ages up to 28 days. These strengths are based on laboratory tests with complete moist curing at 70°.

However, job concrete is seldom thoroughly cured. That is why 'Incor' has a big advantage—because it makes much more efficient use of the limited time concrete is usually kept wet.

Ordinary cement cures less efficiently than 'Incor'; therefore, to allow for loss of strength in drying out, it is advisable to design a mix on the 7-day moist-cured strength, to be sure of getting 28-day design strength under job conditions. Thus, if the 28-day strength is 2500 lbs., select the water content indicated in Fig. 3 for this strength at 7 days—that is, 6½ gal.

With 'Incor' you are not concerned primarily with the 28-day strength—what you want is a workable, durable concrete which gives stripping strengths at early ages. Since the 3-day strength with 'Incor' is about the same as the 28-day strength with ordinary cement, select a mix which will produce the design strength in 3 days. Thus, if the design strength is 2500 lbs., use the water content in Fig. 2 giving that strength at 3 days—that is, 7½ gal.

WORKABILITY: Fig. 4 shows how water content and proportions of mix affect workability. It can be used with Fig. 2-3 to design a mix for a given water content and slump. Example:

From Fig. 2, select the water content necessary to produce 2500 lbs. strength with 'Incor' at 3 days—that is, 7½ gals. Then enter Fig. 4 on the 7½ gal. line until it intersects the desired slump. Thus, for a 6-in. slump concrete, a mix containing 660 lbs. of aggregates per bag of cement is indicated. Make a trial batch for these proportions of cement and the aggregates on hand (using about 35% sand).

Required consistency can readily be obtained by varying the proportion of sand, or by increasing or decreasing the total amount of aggregate. The quantity of aggregate per bag of cement should be based not only upon maximum economy of ma-

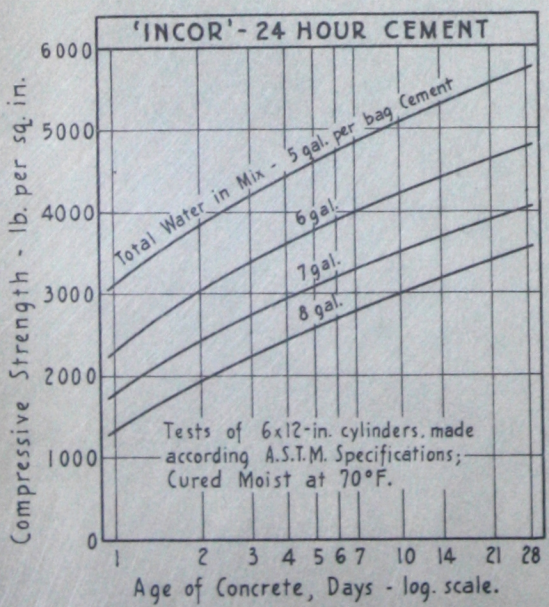


FIG. 2

FIG. 2-3: Typical age-strength curves for 'Incor' and ordinary Portland cement, based on laboratory tests of concrete moist-cured at 70°F. These curves show influence of water content on concrete strengths. Example: An 8-gal. mix with ordinary Portland cement indicates, at 28 days, 2500 lbs. per sq. in., compared to 4800 lbs. per sq. in. for a 5-gal. mix. Same mixes with 'Incor' indicate 3500 lbs. with 8 gal. and 5700 lbs. with 5 gal. of total water per bag of cement. Field strengths depend upon duration of moist-curing and temperatures on the job. If concrete is permitted to dry out, strength is reduced. Because 'Incor' makes more efficient use of the limited time concrete can be kept wet, it produces stronger, denser, more watertight concrete.

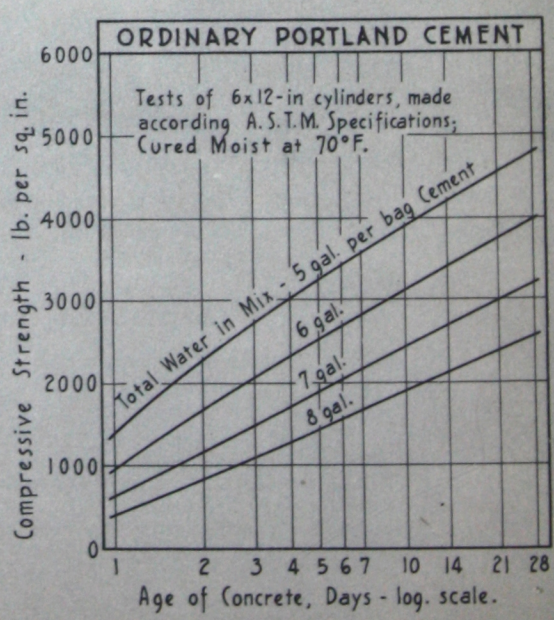


FIG. 3

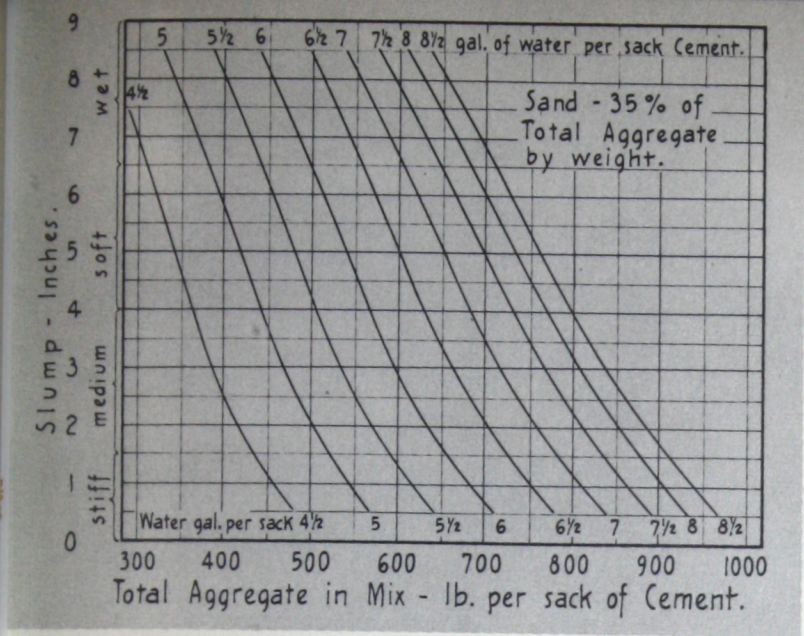


FIG. 4: Shows how water content and proportions of mix affect workability. This diagram, with Fig. 2-3, can be used to design a mix for given water content and slump. It is based on mixtures with sand and gravel as coarse aggregate. Similar relationships will be found for other aggregates.

terials but also upon the cost of placing. Do not try to increase workability by adding more mixing water, because excessive water greatly reduces both early and ultimate strengths.

COLD-WEATHER CONCRETING: Fig. 5 may be used to estimate the strengths of concrete exposed to low temperatures. To overcome this strength-retarding effect, it is necessary to heat materials and retain the heat until concrete hardens sufficiently to go it alone. Obviously, the quicker concrete hardens, the less time and expense are required to provide heat.

With 'Incor', you simply heat mixing water and aggregates, and provide heat-protection for 24 hours after concrete is placed. With ordinary cement, at least two additional days' heat curing should be provided. Following example illustrates savings with 'Incor':

6-story concrete frame—100' x 100'.
30 salamanders required to provide heat per floor.

Operating Costs:

Coke, 5 tons a day, at $8.....$40 per day
Labor, 4 men tending fires, at $5.....20 per day
Heat Cost.....$60 per day

'Incor' Saves:

2 days' heating expense per floor.....$120
For 6 stories and roof.....$840

These savings in fuel and labor are usually accompanied by a substantial reduction in erection time, which means reduced overhead costs as well.

* * *

So, it all comes down to this: Winter or Summer, it pays, and pays well, to analyze the cost of non-productive time in concrete-frame erection. It isn't too much to say that 'Incor' often spells the difference between profit and an even break or an actual loss, if costs are carefully figured—and those are the only kind worth keeping.

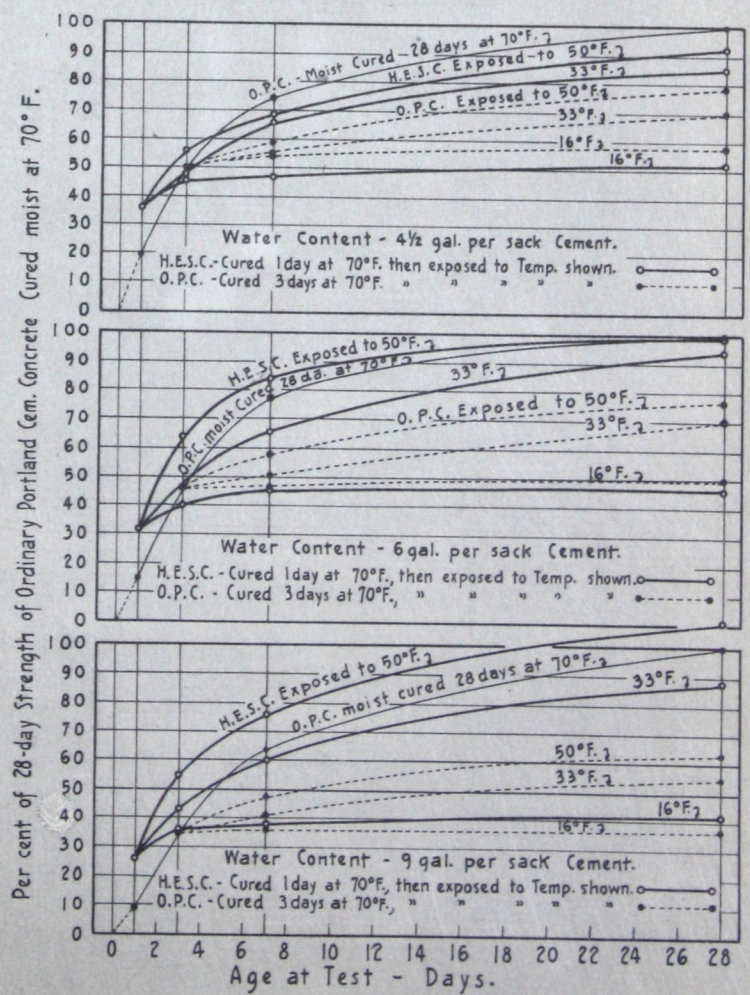


FIG. 5

FIG. 5: Relative strength values of high-early-strength cement cured at 70° for periods indicated, then exposed to sub-normal temperatures, are shown as a ratio of the 28-day strength of ordinary Portland cement, cured moist at 70°.

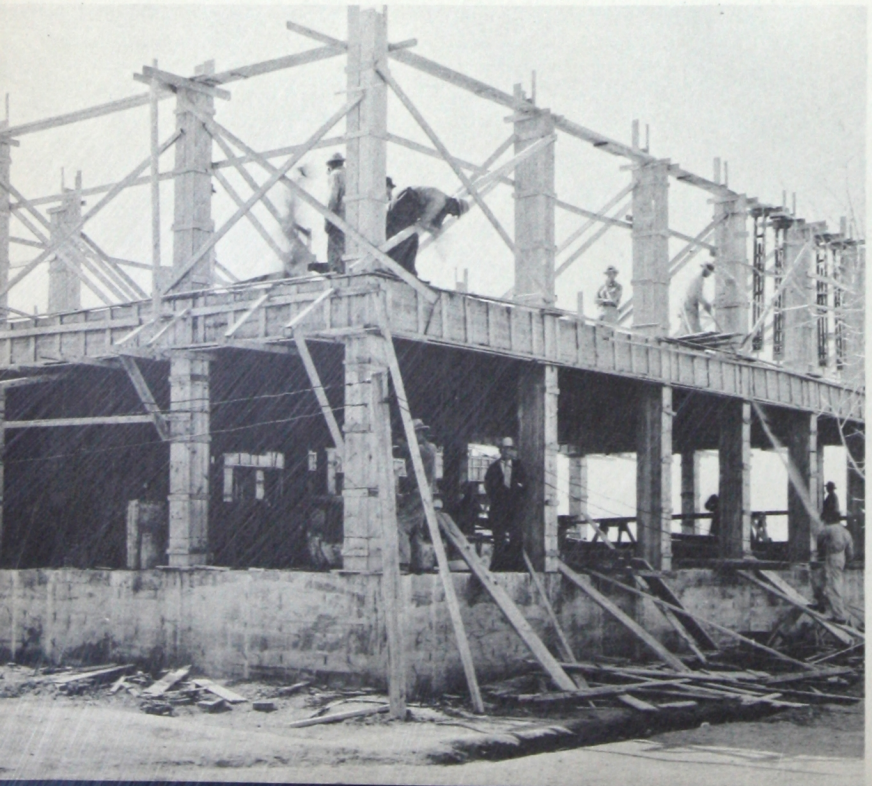
(After data from "Temperature Effects on Compressive Strength of Concrete," by A. G. Timms and N. H. Withey; Proc., Amer. Concrete Inst., Vol. 30, p. 159.)

In Administration Building, Southeastern Louisiana College, Hammond, 'Incor' was used for first and second floors. Forms, stripped in 24 hours, were immediately re-used—45,000 ft. (B.M.) form lumber being required. Contractor estimated form requirements with ordinary Portland cement at 125,000 ft. (B.M.). At $30 a thousand, 'Incor' saved $2400 on form material. . . Quick method, summarized below, enables contractor to estimate savings obtained with 'Incor'.

Reducing Concrete-Frame Erection Costs

WITH 'INCOR' 24-HOUR CEMENT

Used in 2nd-floor forms, joists and slab in State Hospital Building, Wichita Falls, Texas, 'Incor' saved 12 days' overhead—$300; plus $700 on form lumber and make-up. Total saving, $1050. Extra cost of 'Incor', $150. Net saving, $900. Brick work started 12 days sooner, reducing bad-weather shut-down hazard.



QUICK SUMMARY

1. Frame-erection costs divide two ways—(a) direct costs for labor and materials; (b) indirect or overhead costs. Both depend on job conditions. Contractor can vary direct costs but little. But he *can* save on indirect costs, by eliminating non-productive time while concrete hardens.

2. To find savings made possible by 'Incor's' 24-hour service strength, do three things:

(a) From Tables I-II (pages 6-7), find number of working days saved by using 'Incor'.

(b) Calculate job overhead: remember, these costs continue, even when work on frame stops while concrete cures.

(c) Compare saving in overhead against extra cost of 'Incor' or second form-set. A second form often means added cost—'Incor'* usually means a net saving.

3. Frame erection is only place where time can be saved without overtime and increased cost. Enclosing, follow-up operations and everything else wait on frame. 'Incor' speeds up schedules without increasing costs—and usually at a substantial money-saving.

* Reg. U. S. Pat. Off.

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